REMARKS

Applicant requests reconsideration of the present application in view of the foregoing amendments and the following remarks. Claims 3-4, 7, 12, and 16-17 have been amended to correct certain informalities. The Specification has been amended to correct a typographical error. Claims 1-17 remain pending in the present application.

Information Disclosure Statement

The Examiner did not consider one of the references in the Information Disclosure Statement ("IDS") filed on November 25, 2003, because the IDS did not list the publication date for that reference. The publication date for the reference is July 19, 1998. A new IDS citing that reference will be filed shortly after the submission of the present paper.

Examiner's Objections to the Claims

In the Office Action, claim 16 was objected to because of certain informalities. The Examiner pointed out that the word "re-parameterizating" is not in current usage in the English language. Applicant has replaced that word in claim 16 with the term "re-parameterizing." Similar changes were made to claims 7 and 17. Applicant respectfully requests the withdrawal of the objection to claim 16 in light of the amendments to the same.

Indefiniteness Rejections

Claims 3, 4, and 7 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. The Examiner asserted that those claims included terms without antecedent basis. While Applicant disagrees with the Examiner's position, claims 3-4 have been amended to delete the term "the," which appeared before the term "derivatives," in order to expedite prosecution of the present application. For the same reason, claim 7 has been amended to delete the term "of the," which appeared before the term "subdivision surfaces."

The Examiner also rejected claims 1-17 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the invention.

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Specifically, the Examiner asserted unclearness of the terms "iso-parameter lines" and "natural spacing." Applicant respectfully traverses the indefiniteness rejection of claims 1-17 because the Specification and the general teachings of the prior art convey to a person of ordinary skill that (1) the term "iso-parameter line" means a "line of constant parameter value," and (2) the term "natural spacing" means "spacing between iso-parameter lines corresponding to the natural parameterization."

Section 2173.02 of MPEP provides, in relevant part:

"The examiner's focus during examination of claims for compliance with the requirement for definiteness of 35 U.S.C. 112, second paragraph, is whether the claim meets the threshold requirements of clarity and precision, not whether more suitable language or modes of expression are available. . .[t]he essential inquiry pertaining to this requirement is whether the claims set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity. Definiteness of claim language must be analyzed, *not in a vacuum*, but in light of : (A) The content of the particular application disclosure; (B) The teachings of the prior art; and (C) The claim interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made" (emphasis added).

Accordingly, the Examiner must look beyond claim language to determine whether that language is indefinite under 35 U.S.C. §112, paragraph 2. The claim language must be read not in a vacuum, but within the context of the specification of the present application. The claim language must also be read in light of what is known in the art, which might not be disclosed in the patent application document.

A "line" may be defined as "a straight or curved geometric element that is generated by a moving point and that has extension only along the path of the point." *See* Merriam-Webster On-line <http://www.merriamwebster.com/dictionary/line>. An "iso-line" may be defined as "a line on a map or chart along which there is a constant value." *See* Merriam-Webster On-line <http://www.merriamwebster.com/dictionary?va=isoline>. Thus, a person of ordinary skill in the art would recognize that the term "iso-parameter line" means a "line of constant parameter value."

Further, a person of ordinary skill in the art of computer modeling of images would recognize that "natural spacing" of iso-parameter lines refers to the spacing between those lines resulting from natural parameterization of a surface. The concept is explained in more detail on page 7 of the Specification and Figures 4A-C.

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The Specification explains that derivatives computed based on natural parameterization diverge around extraordinary points corresponding to vertices of valence greater than 4. The valence of a vertex may be defined as the integer number equal to the number of faces incident to that vertex. The behavior of the derivatives can be examined by looking at iso-parameter lines. Figures 4B-C show how the natural spacing tends to increase as the iso-parameter lines approach the corresponding extraordinary vertices of valence 5 and 13, respectively. Nevertheless, for the extraordinary vertices with a valence not greater than 4, the natural spacing does not increase. Figure 4A illustrates precisely that point for an extraordinary vertex with a valence of 3. The teachings of the Specification and Drawings of the present application clearly convey that the term "natural spacing" refers to the spacing between iso-lines corresponding to the natural parameterization.

In view of the foregoing discussion, Applicant respectfully submits that the terms "iso-parameter line" and "natural spacing" have a well defined meanings in the prior art. Therefore, claims 1-17 are not indefinite and the rejection should be withdrawn.

Enablement Rejection

The Examiner rejected claims 1-17 under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. Specifically, the Examiner seemed to assert that the claimed "*natural spacing* that occurs as the lines of the *Catmull-Clark* model approach the *extraordinary vertex*" cannot be made or used without undue experimentation.

Section 2164.01(a) provides, in relevant part:

"There are many factors to be considered when determining whether there is sufficient evidence to support a determination that a disclosure does not satisfy the enablement requirement and whether any necessary experimentation is "undue." These factors include, but are not limited to:

(A) The breadth of the claims; (B) The nature of the invention; (C) The state of the prior art; (D) The level of one of ordinary skill; (E) The level of predictability in the art; (F) The amount of direction provided by the inventor; (G) The existence of working examples; and (H) The quantity of experimentation needed to make or use the invention based on the content of the disclosure."

The Examiner questioned the "constraints and limits" of the natural spacing recited in the claims. That, however, is not a factor in determining whether the level of experimentation is

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undue. The basis for the rejection is thus not clear.

For argument's sake, Applicant assumes that the Examiner meant to argue that a person of ordinary skill in the art would have to unduly experiment to make and use the invention because the inventor did not indicate in the Specification (1) how the natural spacing changes and (2) to what point it changes as the lines of the Catmull-Clark model approach the extraordinary vertex.

The Specification and Figures show that the natural spacing of iso-parameter lines increases as those lines approach an extraordinary vertex with valences greater than four; and decreases as the lines approach an extraordinary vertex with a valence not greater than 4. Further, the specification teaches that the natural spacing results from the natural parameterization of a surface. Thus, the specification teaches that the natural spacing is the result of the natural parameterization and teaches how that spacing changes depending on the valence of an extraordinary vertex. The specification does not teach tweaking the natural spacing to meet a particular spacing requirement. Instead, it teaches a re-parameterization method that results in iso-parameter lines with a new spacing different than the natural spacing

The invention has actually been implemented and a flowchart of the algorithm used in the implementation is described in detail in Figures 5-8. Implementing the steps in the algorithm will result in the re-parameterization of subdivision surfaces, which in turn results in iso-parameter lines with spacing different than natural spacing. There is no reason to further experiment and in fact there is nothing to experiment with. The natural parameterization is given once the subdivision surface is given; one does not have the latitude to experiment with it or with the natural line spacing as the Examiner suggests. If one is unhappy with the fact that the derivatives under the natural parameterization diverge, then there are two options: create a re-parameterization scheme, or use the re-parameterization scheme of the present invention which, to the best of Applicant's knowledge, is the first such method to address this issue in a robust fashion. In view of the foregoing discussion, Applicant respectfully traverses the enablement rejection of claims 1-17.

<u>Utility Claim Rejection</u>

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The Examiner rejected claims 1-17 under 35 U.S.C. § 101 as being directed to non-statutory subject matter. As to claims 1, 2, and 7, the Examiner has argued that the language in those claims is directed towards a change of a model, which amounts to a manipulation of an abstraction, and not towards a change in a tangibly embodied item. Further, the Examiner indicated that the claimed surface is not an actual surface in the real world but a mathematical construct. Still further, the Examiner argued that re-parameterization merely amounts to changing the values of variables in a formula.

In sum, the Examiner took issue with three terms: re-parameterization; model; and surface. Applicant traverses the utility rejection because the claims do not recite abstract ideas, but instead recite the practical application of a computer modeling technique that yields useful, tangible and concrete results.

Section 2106.02 of the MPEP provides that "[w]hile abstract ideas, natural phenomena, and laws of nature are not eligible for patenting, methods and products employing abstract ideas, natural phenomena, and laws of nature to perform a real-world function may well be." A claimed invention is directed to a practical real-world application when it produces a useful, tangible, and concrete result. *Id.*

A concrete result is one that is substantially repeatable. *Id.* Here, the results from the application of the present invention depend on the application of the re-parameterization algorithm. A person of ordinary skill in the art would recognize that the results are essentially invariable for a given set of initial conditions to the algorithm. Consequently, the present invention meets the concrete result requirement of 35 U.S.C. § 101.

The present invention is useful as well. A paper titled "Differentiable Parameterization of Catmull-Clark Subdivision Surfaces," co-authored by the Applicant, was based on the present invention and published on July 2004 (Proceedings of the Symposium on Geometry Processing, France). That paper is actually cited in the work of Martin Marinov <http://darwin.bth.rwthaachen.de/opus3/volltexte/2007/1761/pdf/Marinov_Martin.pdf>. The Marinov paper (see page 23) points to this invention as being useful in solving instabilities in computer modeling. Therefore, the present invention, meets the usefulness requirement of 35 U.S.C. § 101.

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According to Webster's' Third New International Dictionary of the English Language Unabridged 2337 (Philip Babcock ed., 1993), the word "tangible" means "able to be perceived as materially existent." Here, each of the three terms that the Examiner took issue with produce "tangible" results, as required by 35 U.S.C. § 101.

The "model" recited in the claims includes lines - a graphical element which may be described in mathematical terms - and vertices. Lines and vertices are both clearly capable of being perceived through the human eye, and are clearly quantifiable. The fact that they can be described in mathematical terms does not negate the fact that they are tangible. Because the models recited in the claims constitute tangible elements and because the USPTO has issued patented claims that recite that very same term, the Examiner's objection to the inclusion of the term "model" in the claims is respectfully traversed. *See* claims in U.S. Patent No. 6,806,874 for the term "model."

Parameterization may be defined as the specification of a curve, surface, etc., by means of one or more variables which are allowed to take on values in a given specified range. *See* < http://mathworld.wolfram.com/Parameterization.html>. Re-parameterization can be characterized as a method of computing the specification of a curve or surface. The application of that method in the present invention results in the new set of iso-parameter lines, which are tangible, as discussed above. Further, the spacing in between those lines is quantifiable. Therefore, even under the Examiner's assumption that the term "re-parameterization" amounts to a mathematical abstract, re-parameterizing clearly leads to a tangible result: iso-parameter lines. Because the term "re-parameterization" yields tangible results and because the USPTO has issued patented claims that recite that same term, the Examiner's objection to the inclusion of the term "re-parameterization" in the claims is respectfully traversed. *See* claims in U.S. Patent No. 6,806,874 for the term "re-parameterization."

The "surface" referred to in the claims relates to the term "re-parameterization." The re-parameterization of a surface results in a set of iso-parameter lines with a new spacing. As discussed, those lines constitute a tangible result. Therefore, Applicant respectfully traverses the Examiner's objection to the inclusion of the term "surface" in the claims.

In addition to asserting deficiencies in claims 1, 2, and 7, the Examiner alleged

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deficiencies in claim 16. Specifically, the Examiner argued that the claim language is ambiguous as to the actual components of the system. Applicant submits that the claim language is not ambiguous because it does not recite specific components of the system. It simply recites means for implementing a function, a function which is clearly and unambiguously described by the claim language.

If the Examiner referred to a deficiency in the Specification, then Applicant respectfully submits that there is none. Applicant directs the Examiner's attention to pages 11-13 of the present application, where the operation of one embodiment of the system is described. The Specification provides that "models" may correspond to scanned images of objects and that the system of the present invention may include a database for storing those models. Those models may be represented as subdivision surfaces.

In addition, the Specification provides that at least in one embodiment, the algorithms for re-parameterizing the subdivision surfaces are stored in a memory. A person of ordinary skill in the art would recognize that the processor illustrated in the Figures may be used to execute those algorithms to carry out the re-parameterization function. For the foregoing reasons, both the claim language and the specification clearly describe the re-parameterization system of the present invention.

Finally, the Examiner argued that claim 17 describes software and that software per se is not patentable. In support of his arguments, the Examiner cites to the MPEP 2106.01 FUNTIONAL DESCRIPTIVE MATERIAL: "DATA STRUCTURES" REPRESENTING DESCRIPTIVE MATERIAL PER SE OR COMPUTER PROGRAMS REPRESENTING COMPUTER LISTINGS PER SE. Applicant respectfully submits that application of that section is misplaced. That section of the MPEP simply provides that actual computer code listing is not patentable per se. It does not support the proposition that software is not patentable. Because claim 17 is not a computer listing, that section of the MPEP is inapplicable in the analysis of the claim. Therefore, the rejection of the claim should be withdrawn.

For the foregoing reasons, Applicant traverses the utility rejection of claims 1-17.

Anticipation Claim Rejections

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The Examiner rejected claims 1-8, 18, and 10-17 under 35 U.S.C. § 102(b) as being anticipated by Henning Biermann. Anticipation of a claim requires that each and every element of that claim be disclosed in a single prior art reference. *See* Section 2131 of MPEP. Applicant respectfully traverses the anticipation rejection of claim 1 because Henning Biermann fails to disclose a re-parameterized model having iso-parameter lines with a new spacing different than natural spacing as the lines approach the extraordinary vertex.

The Examiner seems to suggest that the lines illustrated in Fig. 9 of Henning Biermann amount to the iso-parameter lines of claim 1 which have a spacing different from the natural spacing. The Examiner specifically argued that Figure 9 in Henning Biermann shows uniform lines approaching the vertices. Nevertheless, Fig. 9 in Henning Biermann does not illustrate iso-parameter lines as they approach extraordinary vertices. It merely shows a control mesh at a given subdivision level. If the area around extraordinary vertices of any of the models shown in Henning Biermann were zoomed, the figure would show misbehavior of parameter lines that the present invention corrects. All Henning Biermann objects are under the natural parameterization. Therefore, Henning Biermann does not disclose iso-parameter lines with spacing other than natural spacing. For the foregoing reasons, Henning Biermann does not disclose each and every element of claim 1. Applicant respectfully requests that the anticipation rejection of claim 1 be withdrawn.

Independent claims 2, 7, 16, and 17, each recite an element analogous to the element discussed above in connection with the allowability of claim 1 over the prior art. Therefore, Applicant respectfully submits that those claims should be allowed for the same reasons set forth above in support of the allowance of claim 1. Further, Applicants respectfully submit that all dependent claims should be allowed by virtue of their dependency from allowable independent claims.

Conclusion

As all grounds for rejection have been fully addressed in the present response, Applicant

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earnestly solicits the expedited allowance of the pending claims. Should the Examiner have any questions regarding this communication or feels that an interview would be helpful in advancing the prosecution of this application, the Examiner is requested to contact the undersigned.

Please charge the one-month extension of time fee and any other fee(s) necessary to enter this paper and any previous paper, and credit any overpayment of fees to deposit account 09-0468.

Respectfully submitted,

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